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ABSTRACT

The Project for Minority Student Achievement (PMSA), a 5-year program funded in part by the National Science Foundation, is a program designed to engender systemic change within a segment of a large urban school district in the Los Angeles (California) Basin. Approximately 40% of the student participants were African American and approximately 60% were Hispanic/Latino-American. The program sought to serve 58% of the 90,793 students, 41% of the 6,573 teachers, and all of the principals of the 40 targeted schools. The School of Education of a major urban university, also in the Los Angeles Basin, provided a total of nine long-term activities for students, educators, and school administrators. Students in grades 4 through 10 participated in activities such as the Summer Science/Math Camp and college preparatory survival skills workshops. Teachers participated in planning meetings, team building workshops, and the Science/Mathematics Academy. School principals were involved in the Principal's Institute and planning meetings. College and certain high school students participated in various pedagogical training sessions in order to acquire the skills necessary to assist teachers in the classroom and in tutorials. Parents of the participating students were involved either as observers or as chaperons for field trips. An appendix describes the program focus of the math/science summer camp. (Author/SLD)

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NATIONAL SCIENCE FOUNDATION PMSA PROGRAM: PROMOTING SYSTEMIC CHANGE IN RACIALLY ISOLATED SCHOOLS VIA MATH AND SCIENCE

by T. Jean Adenika-Morrow, Ph. D.

ABSTRACT

The Project for Minority Student Achievement, a five year program funded in part, by the National Science Foundation, is a program designed to engender systemic change within a segment of a large urban school district in the Los Angeles Basin. The School of Education of a major urban university, also in the Los Angeles Basin, provided a total of 9 long term activities for students, educators, and school administrators. Students in the 4th through the 10th grades participated in activities such as the Summer Science/Math Camp and college preparatory survival skills workshops. Teachers participated in planning meetings, team building workshops and the Science/Mathematics Academy. School principals were involved in the Principal's Institute and planning meetings. College and certain high school students participated in various pedagogical training sessions in order to acquire the skills necessary to assist teachers in the classroom and in tutorials. Parents of the participating students were involved either as observers or as chaperons for field trips.

INTRODUCTION

A large urban school district in the Los Angeles Basin (School District), in partnership with the School of Education of a state supported urban university (University), also in the Los Angeles Basin, developed and began executing a five year program designed to improve the science and mathematics achievements of students attending 40 inner city racially isolated schools. The program, Project for Minority Student Achievement (PMSA), involves 40 schools which is comprised of

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27 elementary, 8 middle and 5 senior high schools. In the first year of operation, approximately 40 percent of the participating students were African American and approximately 60 percent were Hispanic/Latino-American.

The participating students were among those who averaged in the first and second quartile on standardized tests. The PMSA program seeks to serve 58% of the 90,793 students, 41% of the 6573 teachers, and all of the principals of the 40 schools within the targeted geographical area. The PMSA program began in 1994 and will continue to operate for an additional four years. This program is unique because the participants will continue to receive follow up instruction and /or other support on a regular basis subsequent to the summer institutes that they initially participated in.

The mission of PMSA is to generate systemic modification of current pedagogical practices in order to produce increased numbers of African American and Latino/Hispanic-American students who take college preparatory courses such as algebra, biology, chemistry, physics, calculus and geometry, and subsequently enter the University as science, mathematics or engineering majors. The projected impact of the PMSA is to double the number of students who enter and complete college preparatory courses in one year with a grade point average of 2.5 or better. In addition, the PMSA program seeks to double the number of students in grades K-9 who entered science or math fairs.

The PMSA Program actively addresses student interest and motivation to study, and seeks to elicit enthusiasm for learning about science and mathematics. Self-esteem and cross cultural issues are also addressed.

Project activities were conducted at the school site, the University, in the field, and during visits to participating technological organizations and industries. Most of the activities were geared towards the students: elementary extended day math discovery teams, math/science camps and tutoring at the University. Middle school activities included science/math clubs and Algebra Ready!/Teen Science!. Senior high activities consisted of language development, mentoring, and an

academic development course. Auxiliary support activities were directed to teachers, to parents of participating students, and to school site administrators.

The PMSA program was designed so that preferred outcomes are associated with current or new practices, and are thereby integrated into the culture and financial fabric of the school. The administrators of the PMSA program have begun to track student progress in order to assist local and state initiatives for increasing the number of students who are prepared to attend postsecondary institutions as math or science majors. The PMSA program was funded by the National Science Foundation and the National Institute of Mental Health. The following summary discusses the long term goals of the program and the resulting outcomes of the program for the first year of operation.

DISCUSSION

Student Programs

Enrichment Program for Senior High School Students

The goal of the senior high school enrichment programs is to increase the number of students who complete four years of high school college preparatory mathematics, science and English/language arts. Specifically, in the first year of the PMSA program, the goal was to increase by 100 at each participating senior high school, students who complete a four year college preparatory program. By the fifth year of the Project, the goal was to increase that number to 500. In order to guide students to take college preparatory courses, ninth graders entering into high school were to be moved off the "general track" and placed into the college preparatory track. 62 percent of these students were projected to increase their standardized test scores in mathematics and language from the first quartile to the second quartile. The acme of the Project was to increase by 25 percent, the number of students graduating from participating senior high schools, of those who enroll in and

graduate from the University system majoring in mathematics, engineering, science or math/science education.

The Summer Workshop for 10th graders consisted of a college survival course and a course on critical thinking skills. These activities were presented within a four hour block of time for four days per week and were held at the University. The purposes of these courses were to motivate the students to enroll in college preparatory courses and to instruct the students on how to achieve academic success in college. Examinations in reading were administered as baseline data for the Project. In addition, students were taught to use the examination process to evaluate themselves in their future coursework.

The students were surveyed at the end of the Summer Workshop. 97 percent of the students reported that the Workshop was useful for self-help. 89 percent reported that they learned important concepts about their cultural history. 95 percent stated that the Workshop caused them to re-evaluate their educational futures, and that they learned strategies for achieving academic success. 100 percent of the students reported that they enjoyed the program and would recommend it to other students.

Enrichment Activities for Middle School Students

The immediate goals of the middle school activities were to increase participation and achievement in science and mathematics of 1400 to 1500 6th through 8th graders. The objective was to increase the number of students entering college preparatory science and mathematics high school courses.

By the second year of the Program, 600 8th grade students were expected to earn average or above average scores on algebra assessments of readiness for college preparatory algebra. 500 of these students were expected to enroll in high school college preparatory classes. In addition, all of the 8th grade participants of the Program were expected to increase their grade point averages to 2.5 (C+) or better in mathematics and science courses. "Alternative" assessment methods would be

administered.

Teen Science! and Algebra Ready! Summer Institute courses for middle school students were planned as separate courses. However, due to the lack of mathematics teachers and the requirement of the School District that credit for the algebra course could only be given if the course was at least five weeks in length, the two courses were held as one. Consequently, many 8th grade students chose to attend the School District's summer school program in order to earn school credit. The Teen Science! / Algebra Ready! course was held four days per week, four hours per day. The course was repeated three times during the Summer.

Science process skills recommended by the *California Science Framework* published by the State of California Department of Education were presented to the middle school students in three subject areas: chemistry, physics and biology. The nature of these subject areas facilitated the teachers' presentations of math concepts. The mathematics concepts and activities used were derived primarily from the Math A Series and Creative Publication Books. The mathematics concepts presented included ratio and proportion, measurement, geometry, logic, problem solving and introduction to algebra in the concrete. The students' responses to the surveys conducted show that as a result of their participation on the PMSA program, the students became science literate, have a better grasp of measurement, and are more interested in college than they were before their summer experience.

The curriculum included math investigations and science experiments. University scientists introduced the students to the science and engineering facilities on the University campus which included: the Accelerator (atom smasher), the Solar Eagle (solar powered vehicle), the Exploratorium (a hands-on physics lab), and the Eagle Track (a high tech physical education track). The last class, the Physics of Roller Coasters, was conducted at an amusement park.

Using an algebra readiness assessment instrument in the first year of the program, the students averaged in the 25th percentile prior to their participation in the PMSA program, and in the 36th percentile subsequent to their participation

which was a net gain of 11 per cent. The PMSA program administrators reported that the gains would have been much higher had there been an exclusive algebra course.

Programs for Elementary School Students

The long range goal of the programs for elementary school students was to strengthen science and mathematics literacy, participation, and achievement for 2,000 to 4,000 4th, 5th and 6th graders. The projected result after two years of operation of the program was to increase standardized test scores of at least 800 4th to 6th grade students from the 20th percentile to the 50th percentile or better in mathematics.

In the first year of the PMSA program, the Math/Science Camp was held for 413 elementary students where math was the predominate feature. Specific math concepts that were taught included: problem solving, measurement, geometry and the relationships within the base ten place value system. The science portion emphasized marine biology and certain theories of energy. The primary goal of the presentation of science concepts was to elicit within the students, the personal satisfaction of solving problems "like a scientist."

A segment of the daily schedule consisted of 30 minute sessions on basic math skills that were presented through music, games, riddles and other activities. University level teaching assistants presented this portion of the Camp. In addition, scientists introduced the students to the same science and engineering facilities that the middle school students were shown. On the last day of the Camp, the students were taken to Cabrillo Marine Biology Museum and Beach to further their study of marine biology.

Examinations on metric measurement and basic skills were administered before and after the Camp. The average pretest score was 37.7 percent. The average post test score was 51.1 percent for a net gain of 13.4 percent for the three week period. The question remains as to what gains could be made if students are taught

math and science using an active and creative approach for the entire school year.

Support Programs for Educators

The goal of this facet of the PMSA program was to present a series of professional development activities in order to enhance the participating teachers' knowledge of math and science in a variety of ways: content, pedagogy, cultural awareness, leadership and alternative assessment. The focus was to teach educators to present high quality lessons in math and science and to articulate methods of directing students into the college preparatory pipeline featuring math and science as preferred majors.

Summer Professional Development Academy for 4th through 8th Grade Teachers

The curriculum for the Summer Professional Development Academy combined active learning math and science lessons. The Academy was held six hours per day, four days per week. The Academy model can be expressed as an equation:

Intensive training +
Practice with participating students +
Testing in the classroom at the school site +
Avid communication with peers

= New pedagogy + Enriched math and science content

After the Summer Professional Development Academy ended, 20 out of the participating approximately 200 teachers, remained to staff the students' activities. Most of the educators did not continue with the PMSA program for financial reasons. The School District offered higher remuneration than the PMSA program. At the conclusion of the Academy, 98 percent of the educators rated the Academy as

favorable. The educators rated the materials provided as above average to excellent. The science activities and the physics workshop were also rated as above average to excellent. The assessment and technology workshops were rated as average.

Student Teacher Training Program for College and High School Students

Five high school students who expressed their aspirations to become elementary school teachers were "trained on the job" as teaching assistants during the Summer Science/Math Camp. College Students were trained as teaching assistants or tutors. Some college students were trained as both. There were three modes of training: (1) assistance in the classroom for 3 hours per day for 33 weeks, (2) attendance in four 3-hour long mathematics training workshops and (3) attendance in the Teachers' Academy on the University campus.

Of the original thirteen college students who worked as teaching assistants, two changed their majors to secondary education, and three changed to elementary education majors. A survey of the teaching assistants revealed that they felt that teaching was difficult yet rewarding. All answered "yes" to the question, "Are you sure you want to do this kind of work?"

Team Building Work Sessions

The Team Building Work Sessions were held on the University campus for one full intensive day per session. Both educators and school administrators participated in the Work Sessions. During the Sessions, program advisory teams discussed the implementation of scheduled activities of PMSA program as complementary components to the offerings at the school sites. Research literature on successful strategies for minority student access to mathematics and science courses was shared and discussed. The school principals' positions on developing minority student achievement were also analyzed. 90 percent of the 43 participating teachers expressed their concerns as to conducting a similar type of program at their school sites. They were also concerned with the level of funding needed to

encourage teacher participation in learning new content and teaching strategies.

Support Activities for School Administrators

The goals of the school-site administrator programs were to increase the leadership proficiency of school principals and to provide leadership in implementing the science and mathematics curriculum and PMSA program initiatives. The principal's role as leader at his/her school-site is pivotal to meeting the objectives of student success: (1) after 2 years of the PMSA program, 40 percent of 10th graders, not previously on the college preparatory track, enroll in and successfully complete (grade "C" or better) college preparatory courses in life/physical/earth science courses and algebra or advanced math, (2) After two years of the PMSA program, 60 percent of 8th graders will enroll in high school college preparatory programs, and (3) after two years of the PMSA program, students from 4th grade to 10th grade raise their grade point averages to 2.5 (C+) or better, using "alternative" assessment methods.

There were two generas of activities for school principals: Principals' Institutes, and seminars on Science, Technology and Learning for Minority Children (4). The first Principals' Institute consisted of 20 intensive hours over a two day period of time. 56 principals and program school-site facilitators attended the Institute. The focus of the Institute was on planning systemic change at their school-sites which served minority children of low-income backgrounds with histories of low academic achievement and low participation rates in math and science. PMSA administrators met with the principals at their school sites for eight consecutive weeks during the fall semester in order to facilitate implementation of the substance of the Principals' Institute.

At the conclusion of the program, the participants were surveyed. The participants reported that they produced high quality products that could be used at their school sites and had obtained useful information during the Institute. However, the highest ratings were given in regard to a keynote speaker, a scientist

from Lawrence Livermore Research Laboratories, who gave a graphic description of what minority children will become if the current society fails to implement effective change in the educational processes.

Curriculum Assembled by Educators in the Summer Institute and Used During Math/Science Summer Camps

The curriculum used during the summer was assembled from a variety of sources to meet the requirements of the California state science and mathematics frameworks and their recommendations through the publication, *Literature for Science and Mathematics.*, published by the State of California Department of Education. The following sources of content and pedagogy were used to produce the Summer Camp curricula:

AIMS Education Foundation: *Activities that Integrate Math and Science;*

University of California, Berkeley, Lawrence Hall of Science: GEMS: *Greater Explorations in Math and Science;*

NCTM: Mathematics Addenda Series: *Geometry and Spatial Sense, Making Sense of Data* and *Number Sense and Operations;*

Glencoe: *Investigating Mathematics: An Interactive Approach*

NSTA: *Science and Children, Science Scope and Amusement Park Physics;*

Creative Publications Books and manipulative for *Hands-on Number Sense and Algebra;*

Dale Seymour Publications for Math and Science Activities (Critical thinking skills)

Cuisenaire Books and Mathematics Manipulatives;

Instructional Faire and The Center for Applied Research: *Education Hands on Science*

Impact of the Partnership Project on the School District

Even at its early stages, the PMSA program had an indirect impact on the

School District via systemic changes at participating school sites. As a result of the Principals' Institute, the elementary, middle school and high school administrators who participated in the program have reported that they were evaluating their academic offerings in mathematics, science and English. In addition, the high school administrators reported developing strategies for incorporating large numbers of students into the college preparatory track who were not previously in the college preparatory track.

Educators who attended the Summer Institute reported sharing the curricula and other materials with their colleagues at the school sites. They also reported that many students who participated in the PMSA program during the summer requested science and mathematics courses during the regular school year. In addition, many of the participating teachers witnessed students sharing their experiences in the program with students who did not attend. Also, teachers and administrators who attended the PMSA program reported that they continued joint dialogues at their school sites in order to develop appropriate changes for their schools. A number of participating elementary school teachers were led to elucidate on their own curricula by using existing resources at their school sites in addition to using the *California Science Framework* published by the California State Department of Education.

Parental Involvement

A long range goal of the PMSA program is to increase parents' active participation in their childrens' education, in their future educational pathways and in participating in meaningful tasks at the school sites. This initiative is connected to programs currently in existence within the School District. The PMSA program Math/Science Project Manager, working with the school-site facilitator, will intensify efforts to include parents in meaningful ways at the school sites. During the Summer Camp/Institute experience, 27 parents visited the classes and observed

the proceedings therein. Eighteen additional parents served as volunteer chaperons during field trips.

CONCLUSION

The success of the PMSA program can be measured in two ways, short term involvement and approval by participants and long term "production" of students who enter and subsequently graduate from universities as math, science, or engineering majors. The latter will take from four years to ten years to ascertain. The former could be seen in the results of the data collections that were done at the end of each session of the program. Ninety percent of the participating teachers and all of the administrators reported that they were interested in replicating the substance of the PMSA program at their school sites. However, the students' approval of their activities and the confidence in themselves that was apparent from their responses to questions that were put to them could be summed up in the responses of two elementary school students, "I learned that doing math and science can be fun and it is more fun than school;" "I learned that we can do math, I can do it now."

APPENDIX A

PROGRAM FOCUS FOR MIDDLE SCHOOL EDUCATORS' FOR MATH/SCIENCE SUMMER CAMP

What The Program is All About!

- provides successful learning experiences in math and science through an enrichment oriented program;
- identifies and focuses on common weaknesses that students often have in the content areas of science and math;
- emphasis given to learning the mathematical concepts necessary for success in pre-algebra: the Math A and Math B concepts and philosophies are utilized;
- instruction and content is delivered through cooperative learning (students learning in groups);
- discovering and learning scientific and mathematical concepts through stimulating and exciting hands-on activities--the way students learn best!;
- investigative problems designed to integrate science and math to provide students with more meaningful learning experiences;
- opportunities provided to help develop and practice critical thinking skills;
- program development incorporates recommendations from the current California State Frameworks in science and mathematics; and
- assessment of student performance is consistent with the new CLAS testing format.

What The Program is Not!

- the program is <u>not</u> implemented in a traditional public school classroom setting: the program is carried out in classrooms at the University;
- the program curriculum is <u>not</u> implemented in a traditional classroom manner; the program curriculum is carried out using currently recommended pedagogical models, strategies, and techniques that help students learn;
- the program is <u>not</u> a remedial program in science and mathematics; and
- traditional homework is <u>not</u> a part of the summer program; the program curriculum places emphasis on students working in cooperative groups and utilizing critical thinking skills to solve scientific and mathematical investigative problems.